هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	**Thermal Physics**
Course Code:	**PHY 1230**
Program:	**Bachelor of Science in Applied Mathematics**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	4
Last Revision Date:	***26/09/2024***

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 6-7/ Year 3-4)					
4. Course General Description:					
Thermal physics is a core subject in physics, applicable to all its subfields. This course covers the basic principles of thermodynamics including some applications. Fundamental principles are taught in depth, and mathematical tools are presented to equip students for other applications. The First and Second laws of thermodynamics are introduced, along with the concepts of temperature, internal energy, heat, entropy and the thermodynamic potentials. Applications of thermodynamic concepts to topics such as heat engines, the expansion of gases and changes of phase are considered. The Third Law, and associated properties of entropy, is introduced. The kinetic theory of gases completes the course.					
5. Pre-requirements for this course (if any)**:**					
General Physics, PHY 1101 and Calculus (2), MAT 1102					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Demonstrate the basic concepts of the principles of thermodynamics.**
- **State the basic principles of kinetic theory of gases for ideal and real gases.**
- **Apply these principles in conjunction with elementary mathematical techniques to solve simple problems in the basic four thermodynamic laws.**
- **Assess whether a solution to a given problem is physically reasonable.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	**0**
Total		60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Demonstrate the basic knowledge of the kinetic theory of gases.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Define and describe the laws of thermodynamics.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Outline the basic concepts of the special functions.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
2.0	**Skills**			
2.1	**Explain and summarize the basic knowledge gained from studying waves and optical physics.**	**S1, S2**	▪ Lectures. ▪ Class discussions. ▪ Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.
2.2	**Develop the students ability to solve and analyze problems in physics related the topics covered by the course.**	**S2, S3**	▪ Problem classes and group tutorial. ▪ Homework assignments as well as problems solutions.	▪ Exams. ▪ Discussions. ▪ Homework.
2.3	**Communicate in a clear and concise manner**	**S4, S5**	• Lectures. • Class discussions.	▪ Exams.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	orally, and using IT for acquiring and analyzing information.		• Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. • Office hours.	▪ Participation. ▪ Homework. ▪ Mini-project(s).

C. Course Content

No	List of Topics	Contact Hours
1.	**Nature of Thermodynamics and Equations of State:** Definitions: System, Surroundings, Boundary, Open system, Closed system, Isolated system, Extensive property, Intensive property, State of a system at equilibrium, Processes (quasi-static, reversible, irreversible, adiabatic, isobaric, isothermal, isochoric, cyclic), Heat reservoir. Temperature and the zero law of thermodynamics, Equation of state of an ideal gas, Van Der Waals' equation for a real gas, Expansivity and compressibility.	**14**
2.	**First Law of Thermodynamics and Applications:** Exact and inexact differentials, Work (reversible and irreversible processes), Adiabatic work and internal energy, Heat, Mechanical equivalent of Heat, Heat capacity, Mayer's equation, Enthalpy and heats of transformation, Relationships involving enthalpy, Gay-Lussac-Joule experiment, Joule-Thomson experiment.	**12**
3.	**Second Law of Thermodynamics and Applications:** Different statements of the second law (Kelvin statement and Clausius statement) Heat engines and the Carnot cycle Irreversible processes, Carnot's theorem, Clausius inequality and the second law, Entropy change in reversible and irreversible processes, Entropy change of the surroundings for a reversible process, TdS equations, Entropy change of an ideal gas, Entropy change for a liquid or solid, Entropy change for a liquid or solid.	**12**
4.	**Thermodynamic Potentials and the Third law of Thermodynamics:** Legendre transformation, Definition of the thermodynamic potentials, Maxwell relations, Helmholtz function, Gibbs function, Chemical potential, Phase equilibrium, Mixing processes, Statements of the third law, Equivalence of the statements, Consequences of the third law.	**12**

5.	**Kinetic Theory of Gases: Basic assumptions:** Molecular flux, Gas pressure and the ideal gas law, Equipartition of energy, Specific heat capacity of an ideal gas, Distribution of molecular speeds, Mean free path and collision frequency.	**10**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (class quizzes, homework, solving problems, etc.....)**	**weekly**	**10 %**
2.	**Midterm Exam 1**	**6thweek**	**25 %**
3.	**Midterm Exam 2**	**12th week**	**25 %**
4.	**Final Exam**	**16th week**	**40 %**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	- Roy B. N, ***Fundamental of classical and statistical thermodynamics,*** J. Wiley& Sons, UK (2002). - Schvoder D.V, ***An introduction to thermal physics,*** Adison Wesley Longman USA (2000). - Russell L.D, ***Classical thermodynamics,*** Inter Edition Saunders College Publ., USA (1993).
Supportive References	Kittel C. and Kroemer H., ***Thermal Physics,*** W. H. Freeman and Company, New York (1980).
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**- Classrooms.** **- Labs.**
Technology equipment (projector, smart board, software)	**- Classroom equipped with a whiteboard and a projector.**

Items	Resources
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students** **Second examiner**	**Indirect (The students complete the evaluation forms at the end of term. Final exam is evaluated by the second examiner)**
Effectiveness of Students assessment	**Instructors**	**Direct (exams, HW, project, …)**
Quality of learning resources	**Faculty** **Students**	**indirect (surveys)**
The extent to which CLOs have been achieved	**Instructors** **Program Leaders**	**Direct (excel sheet)**
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**Quality Unit-Physics Department**
REFERENCE NO.	**Department council No. 06**
DATE	**26/09/2024**